

Mitigation & Control of Vapor Intrusion

Ronald Mosley
EPA/ORD/NRMRL

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Outline

- Present some important mitigation issues
- Discuss selection of a technology
- Describe critical factors in designing mitigation system
- Describe some examples of mitigation system installation
- Discuss verification of system performance
- Discuss long-term operation and monitoring
- Discuss potential deactivation of system
- Summarize



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***To have soil contaminant
problems indoors,
there must be:***

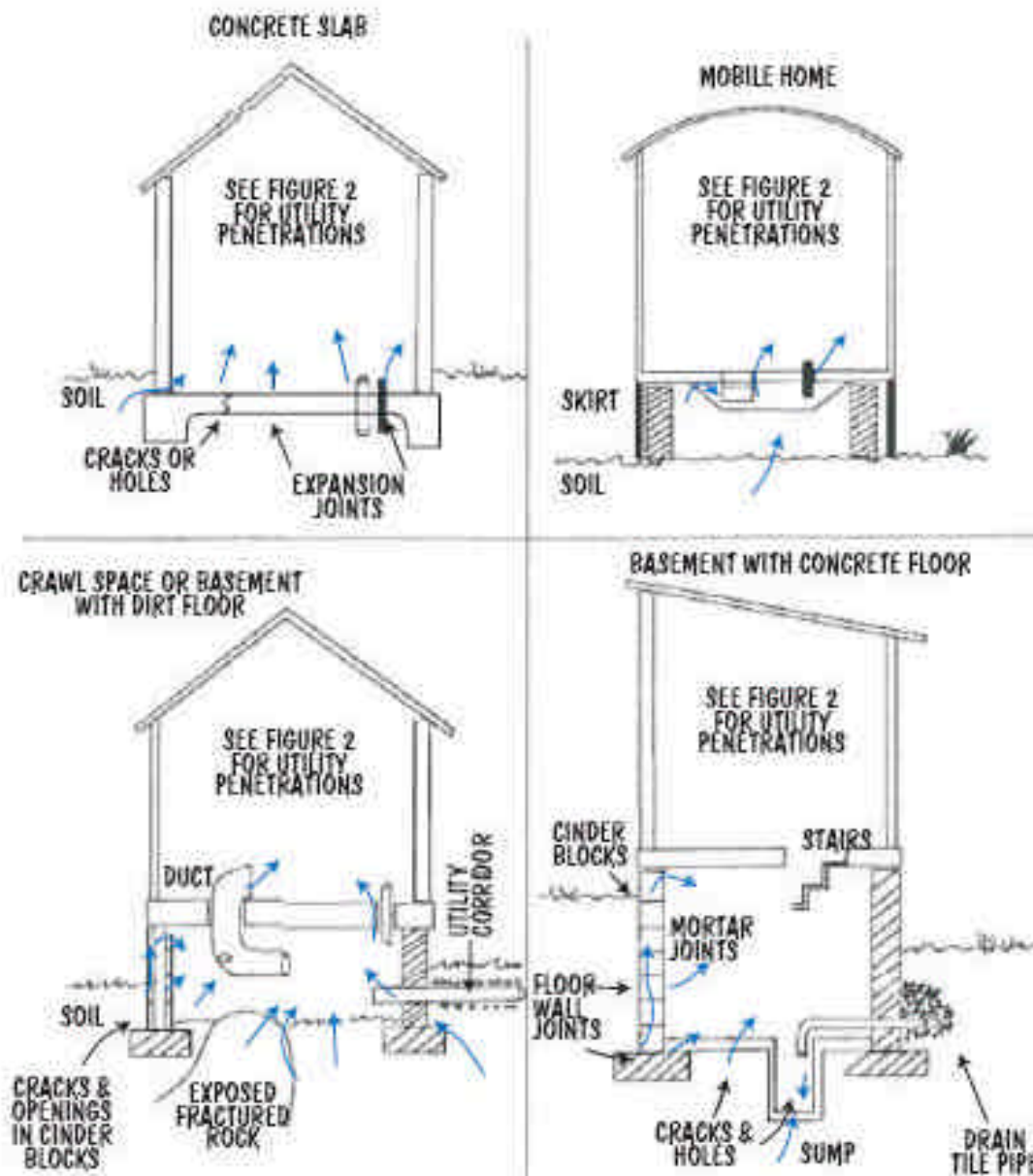
- Sources
- Entry paths
- Driving forces



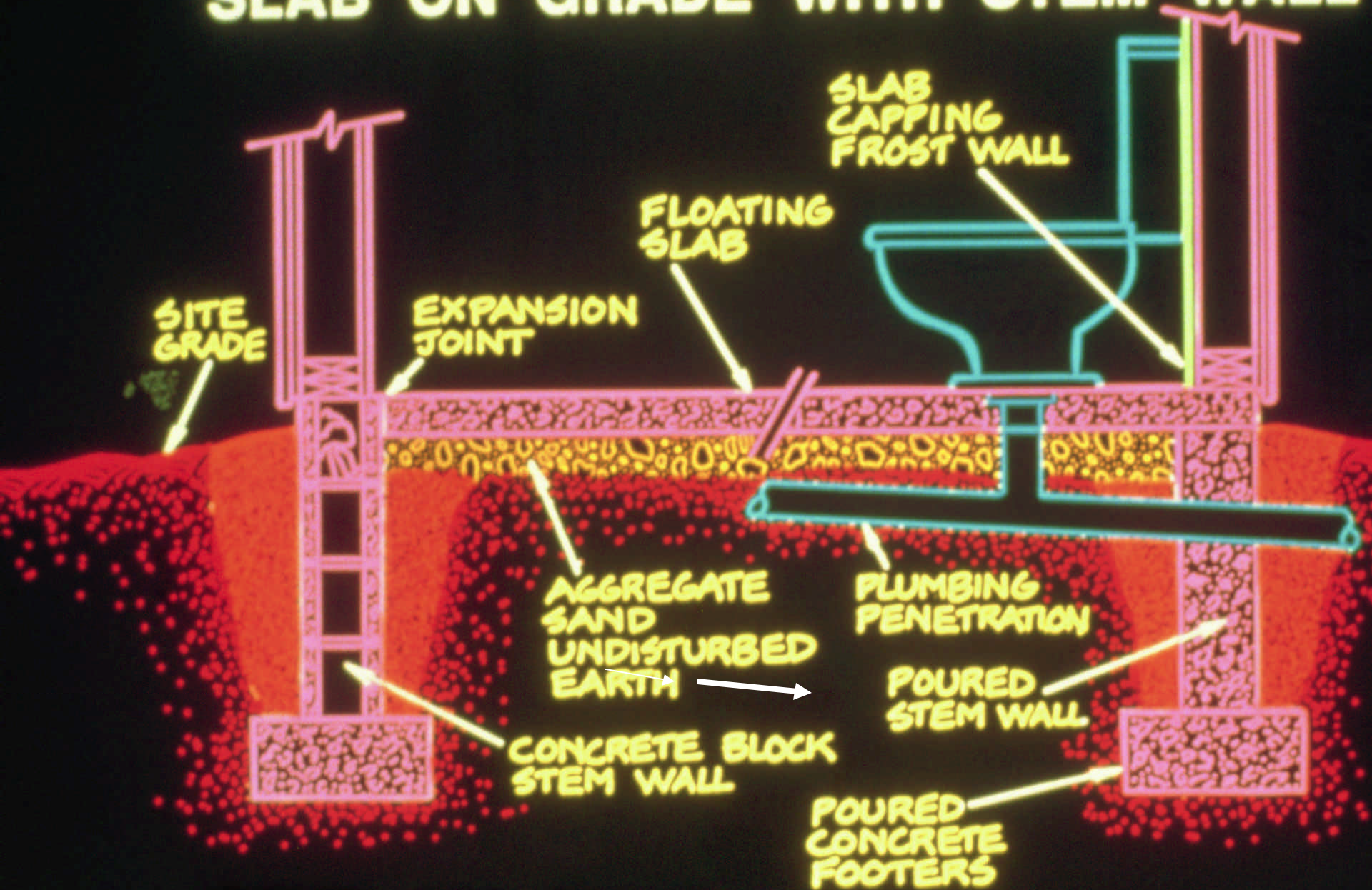
Some examples of entry routes

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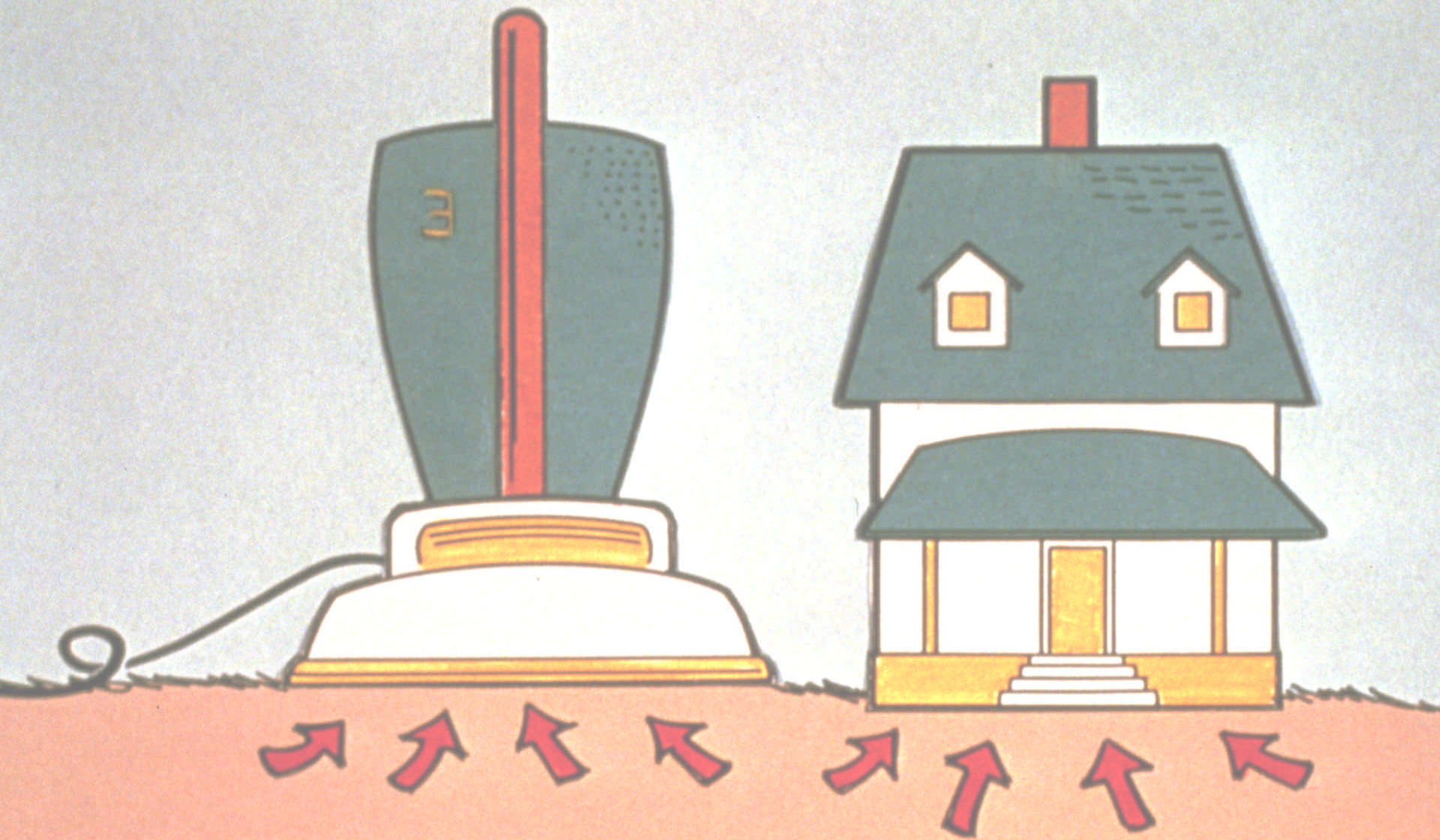


SLAB ON GRADE WITH STEM WALL

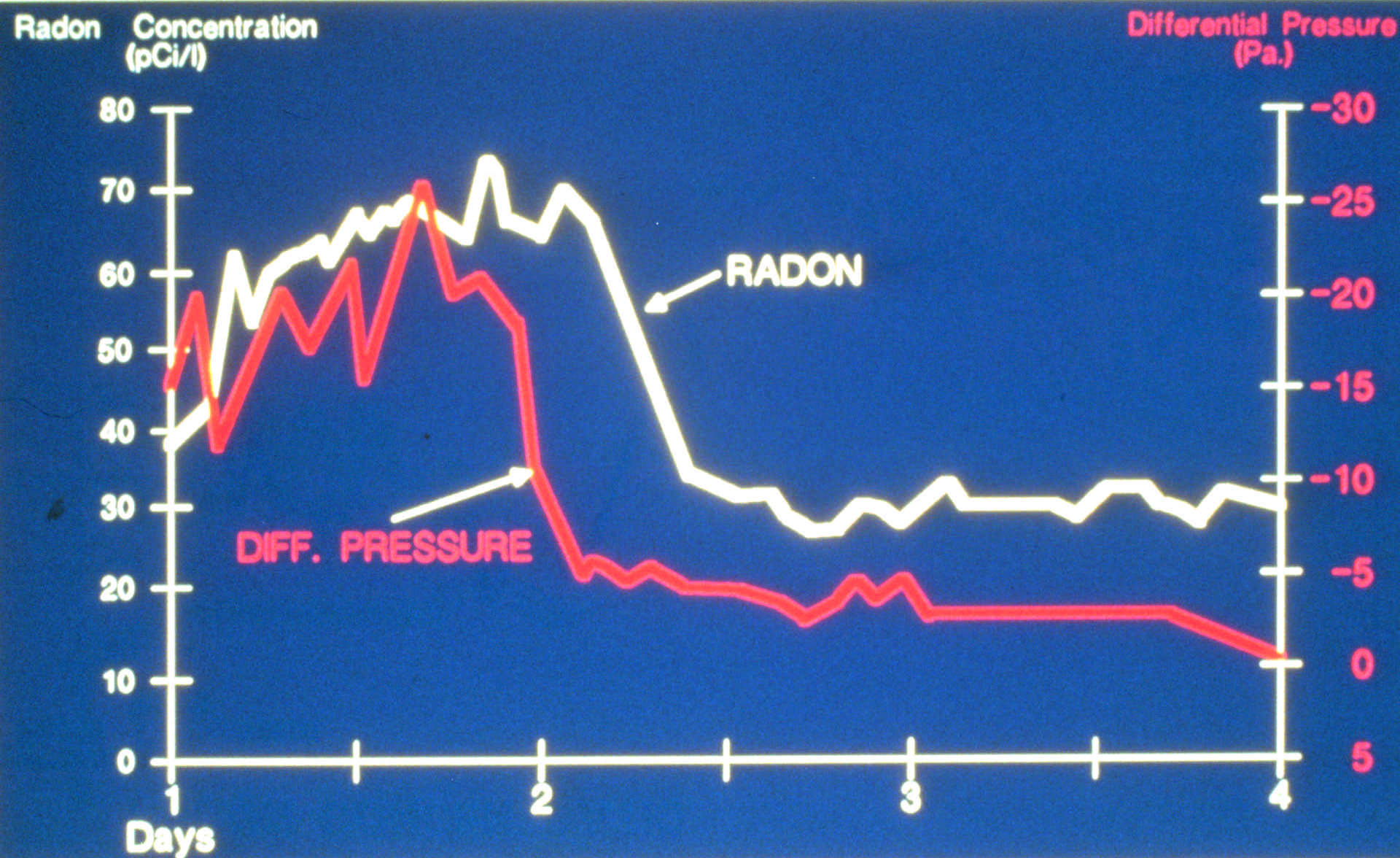








EFFECT OF DIFFERENTIAL PRESSURE ON RADON CONCENTRATION (BEFORE MITIGATION)





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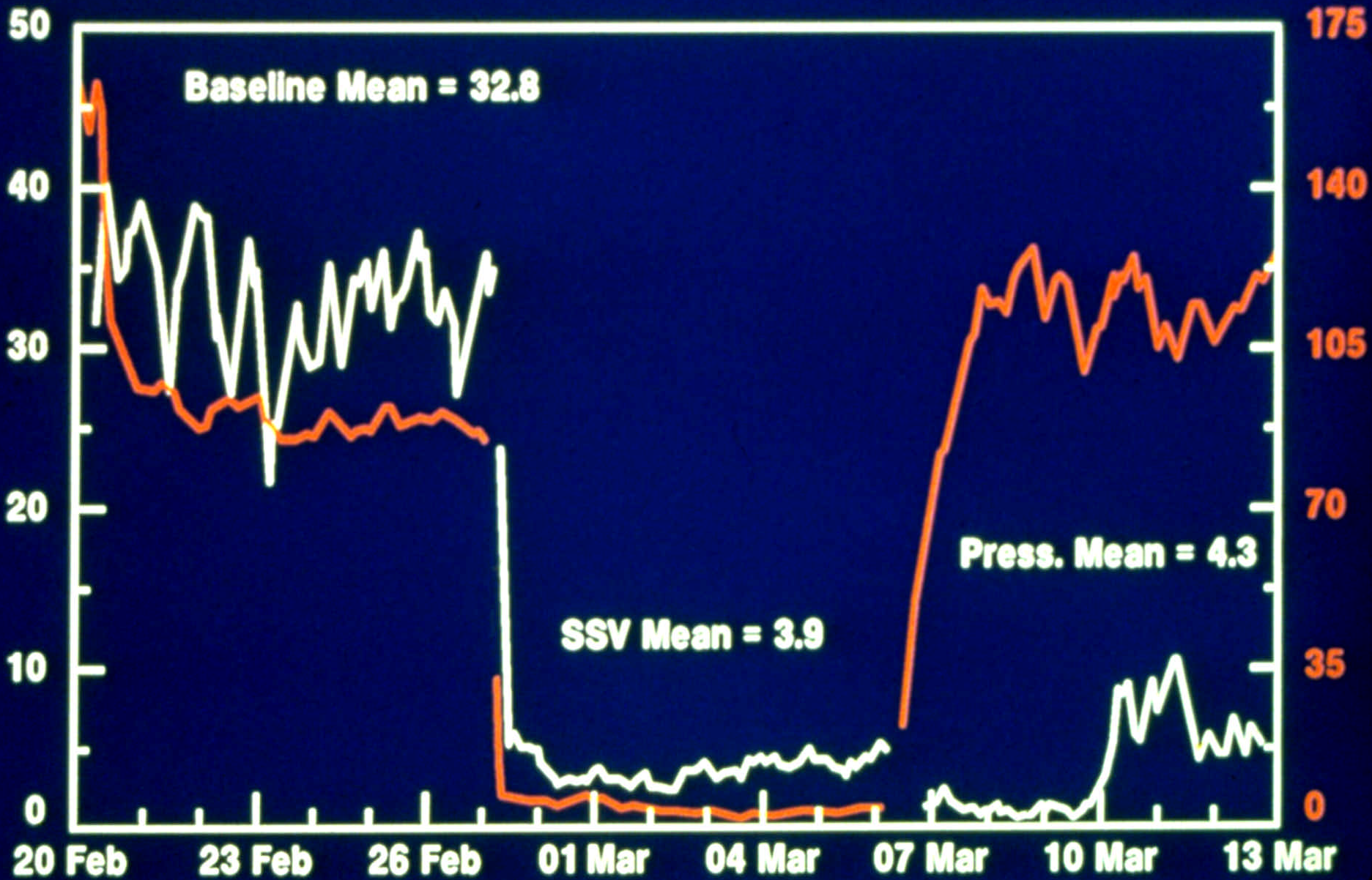
Selecting technologies to reduce indoor contaminants

- Prevent entry
 - Remove entry routes (i.e. sealing)
 - Remove driving forces (soil depressurization)
 - Pressurization
- Remove after entry
 - Ventilation (with/wo heat recovery)
 - Adsorption
 - Catalytic/photo-catalytic oxidation
 - Scrubbers

Subsurface Ventilation vs. Basement Pressurization House LBL11

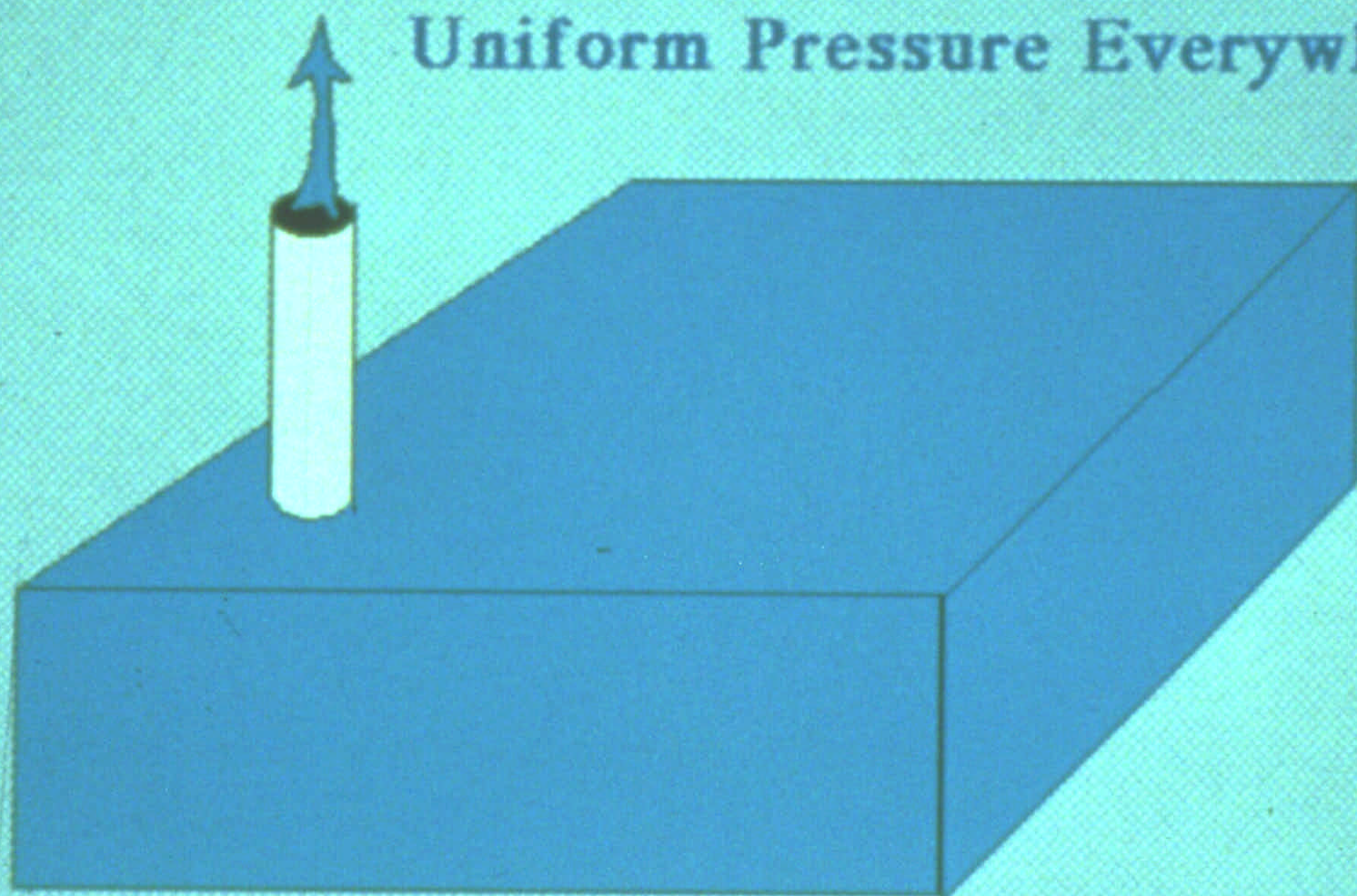
Basement Radon (pCi/L)

Subslab Radon (pCi/L)

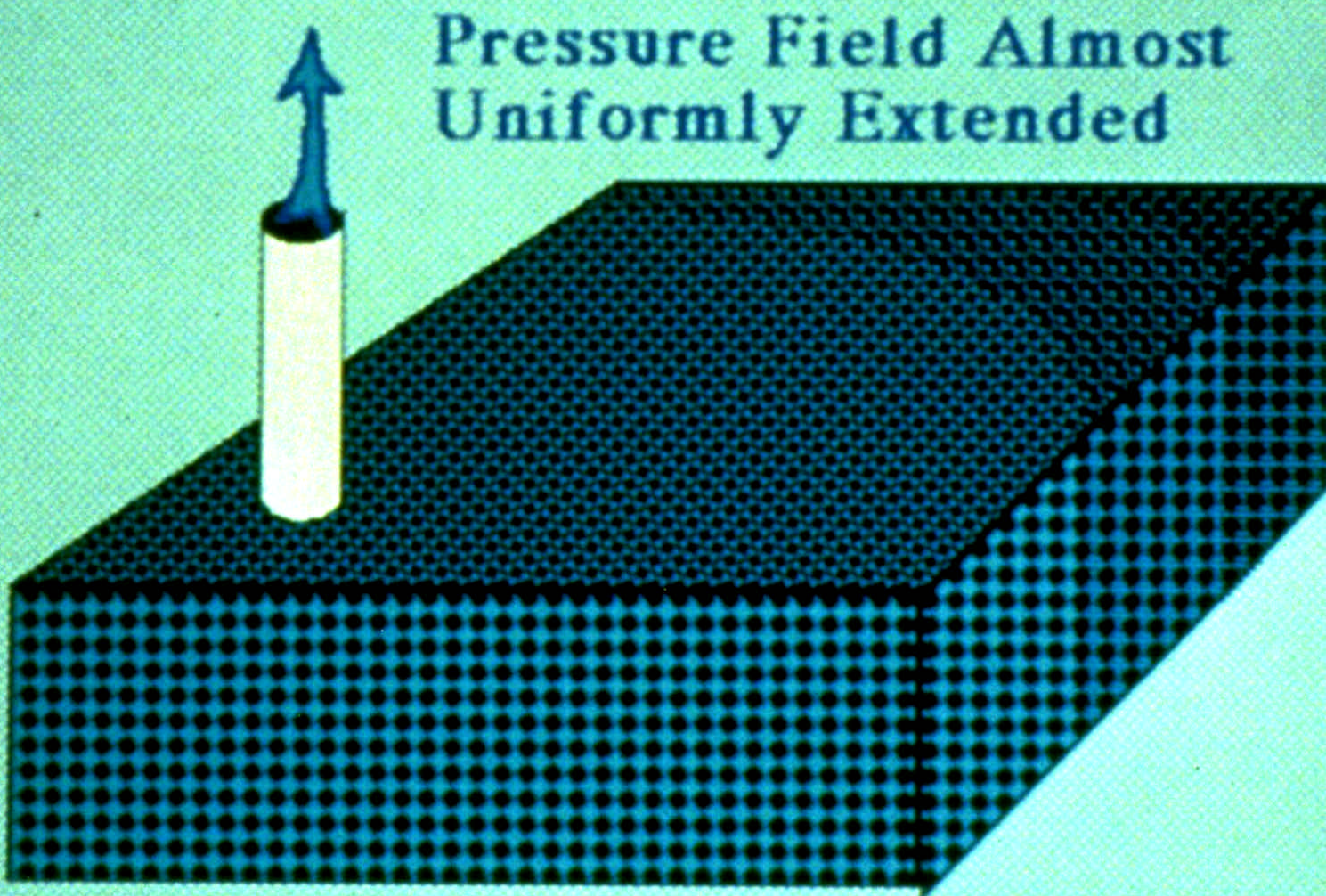


Single Suction Point on an Empty Box

Uniform Pressure Everywhere

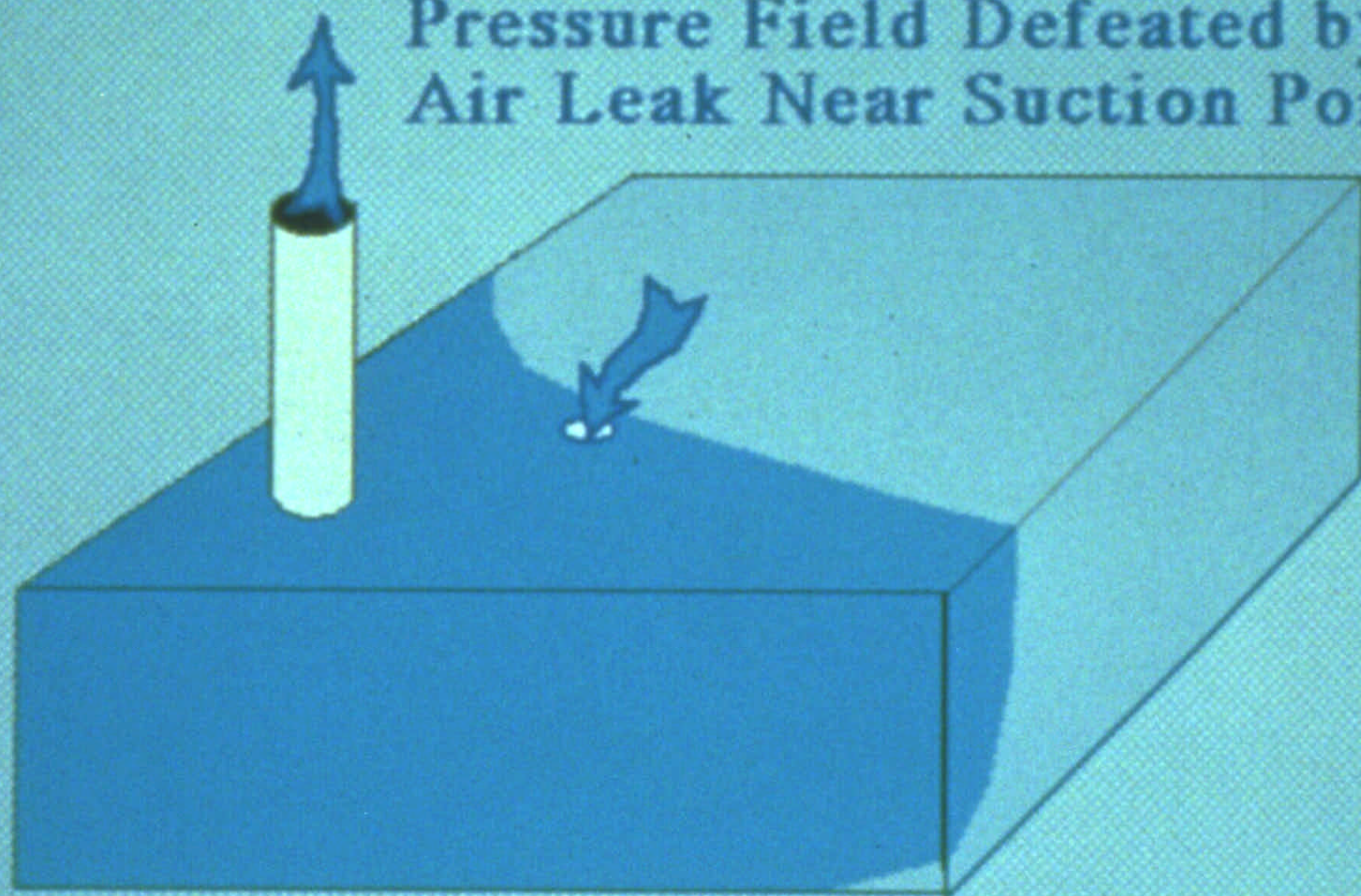


Single Suction Point on a Box with Pebbles

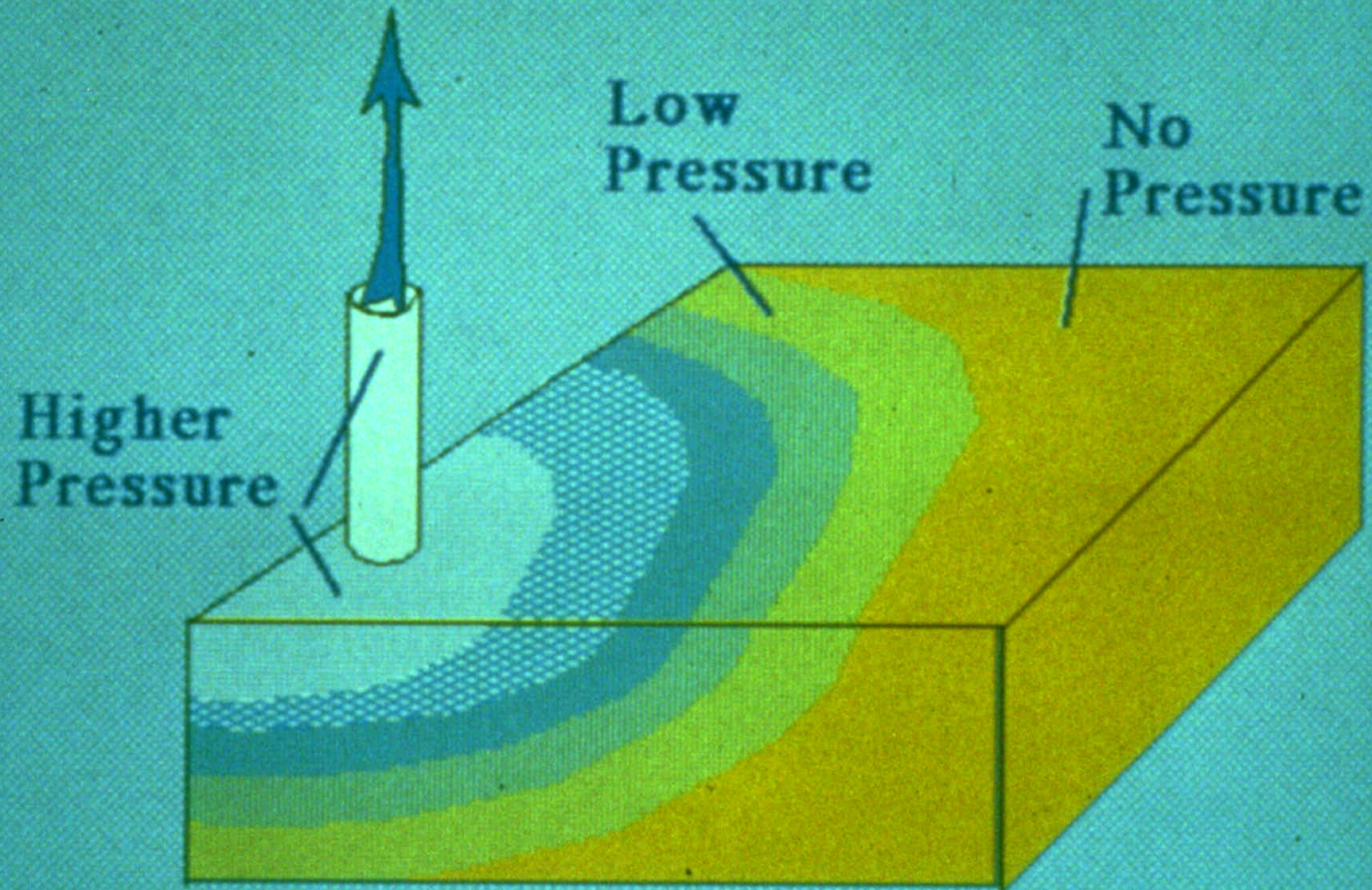


Single Suction Point on an Empty Box with Air Leak

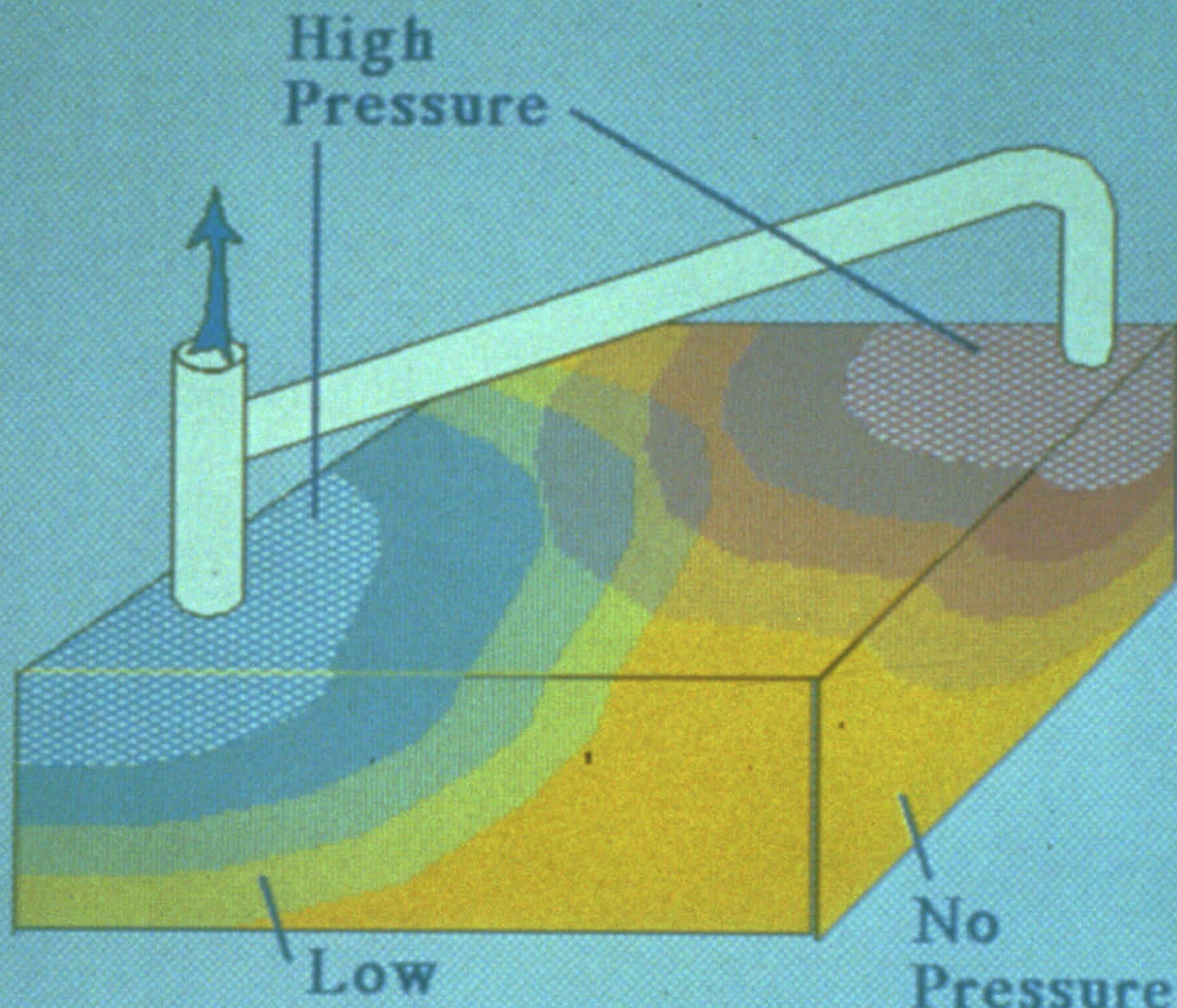
Pressure Field Defeated by Air Leak Near Suction Point



Greater Suction Extends the Pressure Field Further



A Two Suction Point on a Sand Filled Box





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Design Considerations for Soil Depressurization

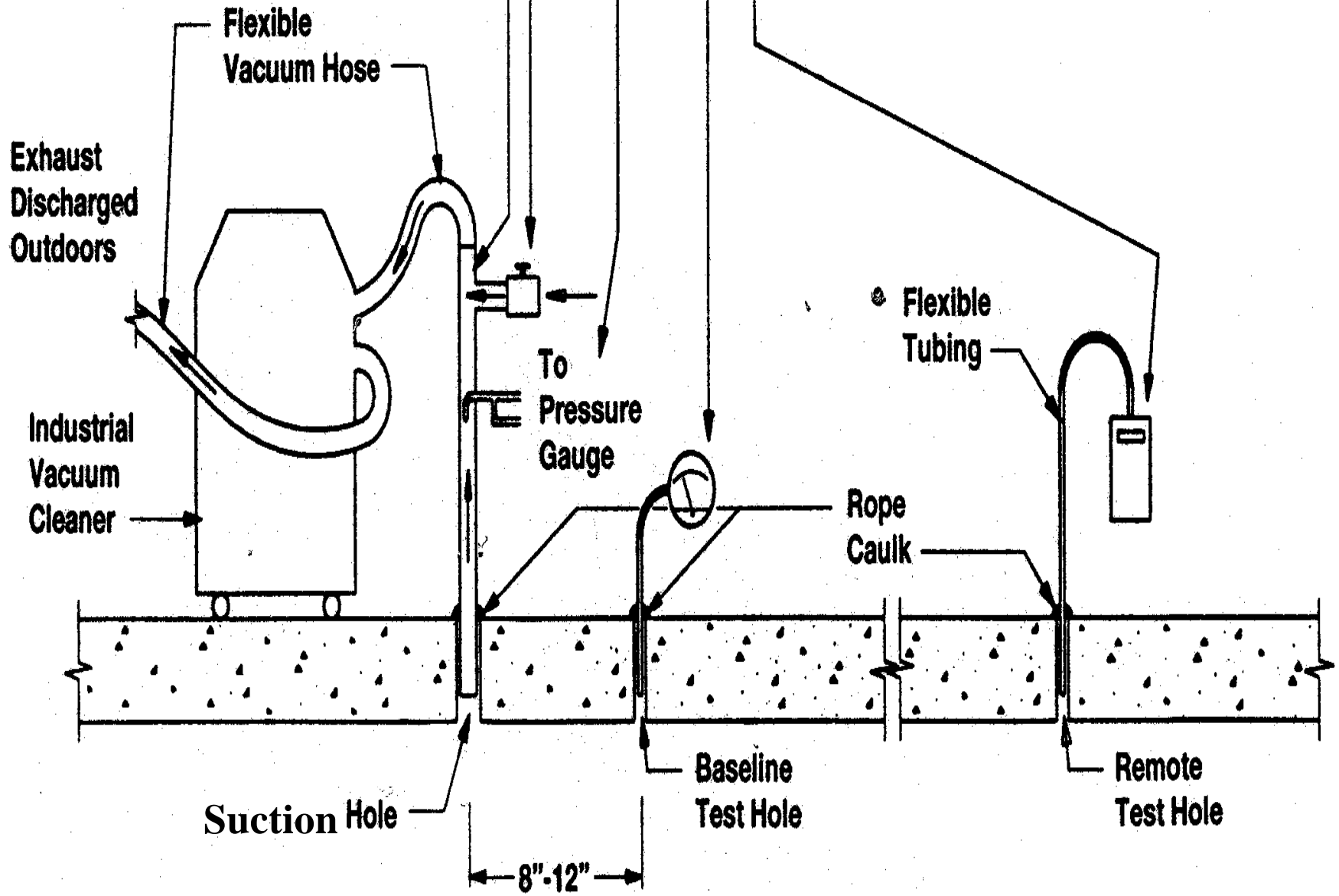
- Developing a pressure field: number and location of suction points, blower capacity, sealing cracks and holes
- Blower and exhaust location
- Ductwork (diameter, length, & bends)
- Tests during mitigation
- Labeling, alarms, and monitoring

Pitot tube

Magnethelic/micromanometer

PVC ball valve
PVC pipe

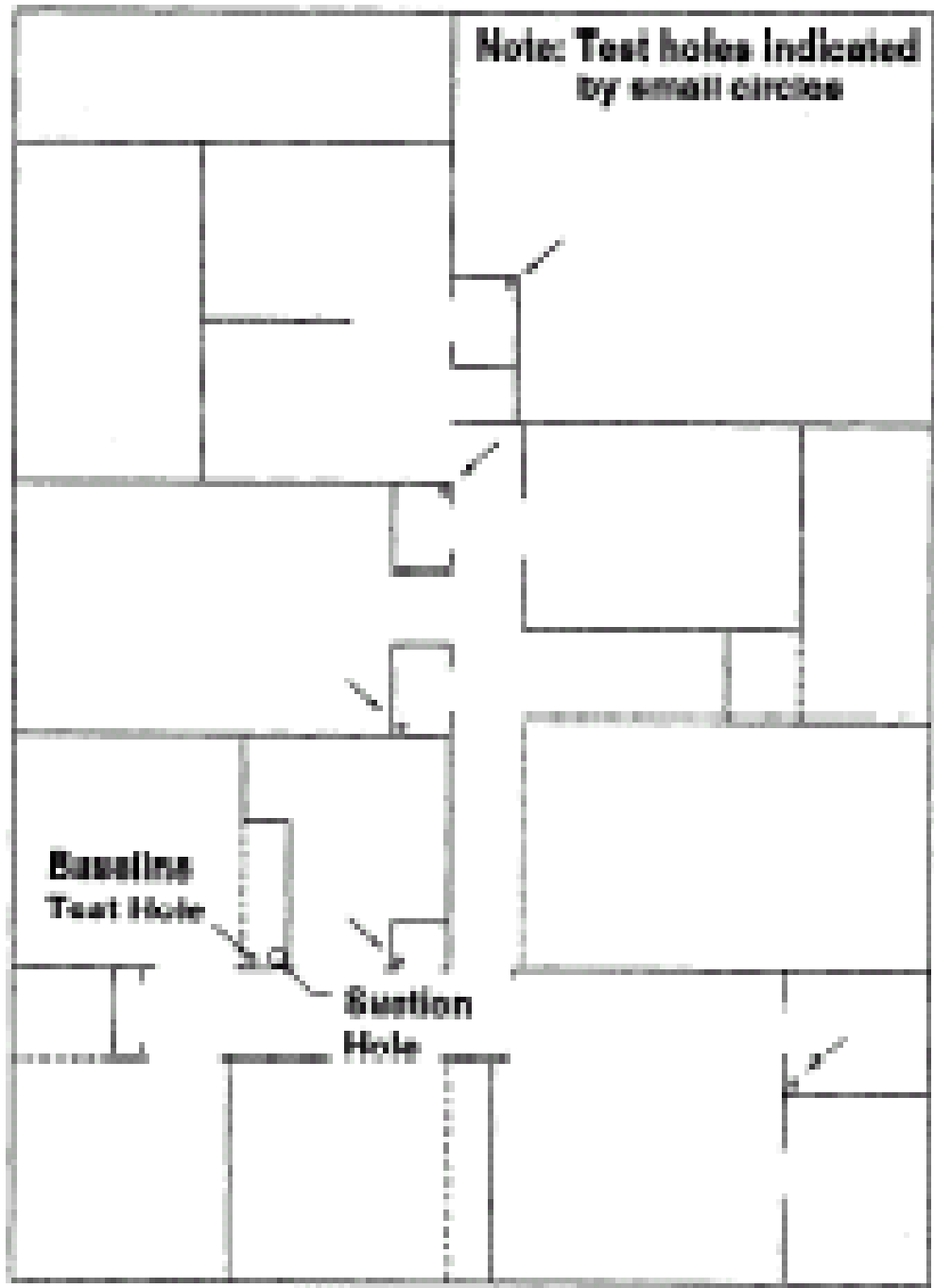
Micromanometer





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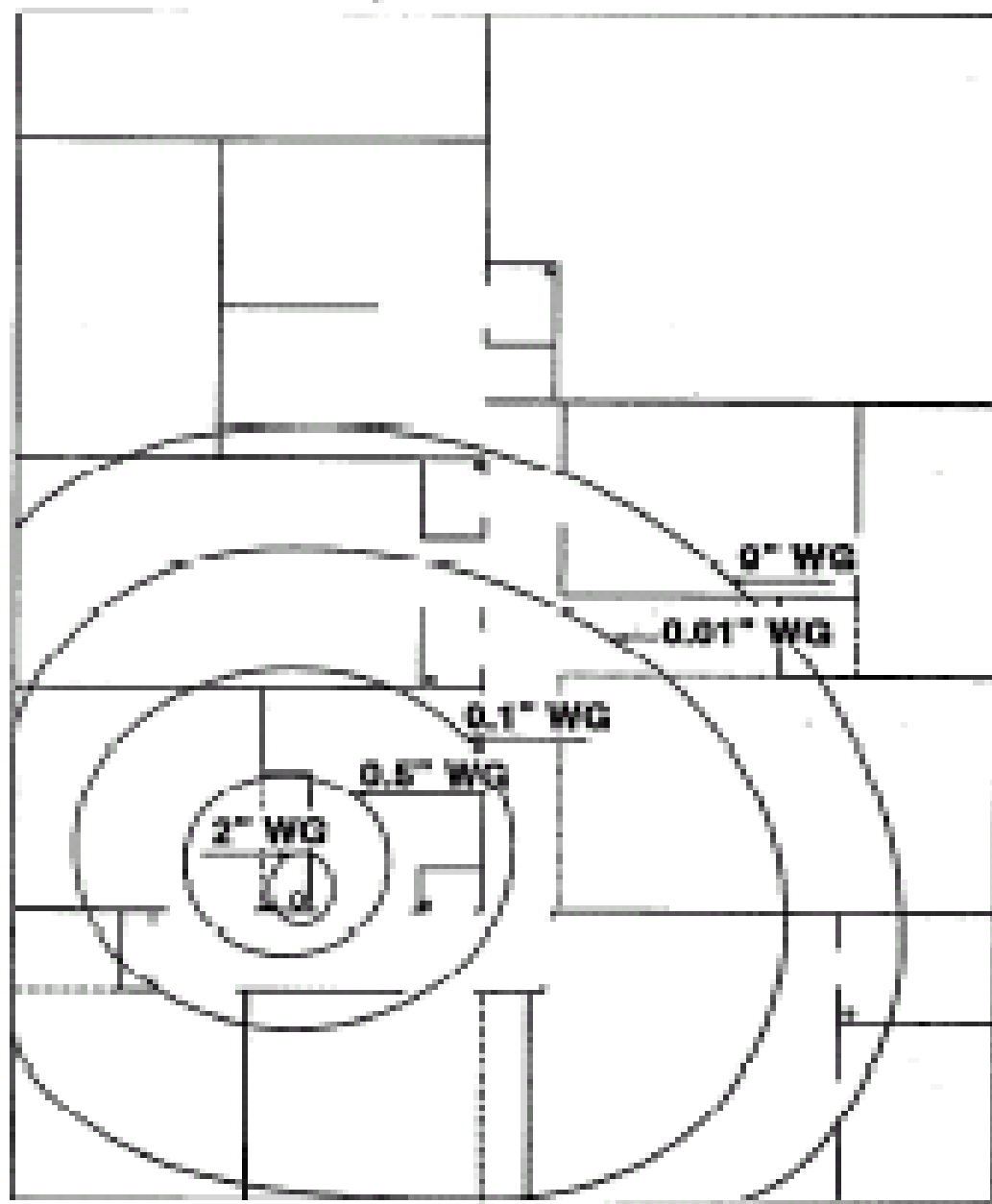
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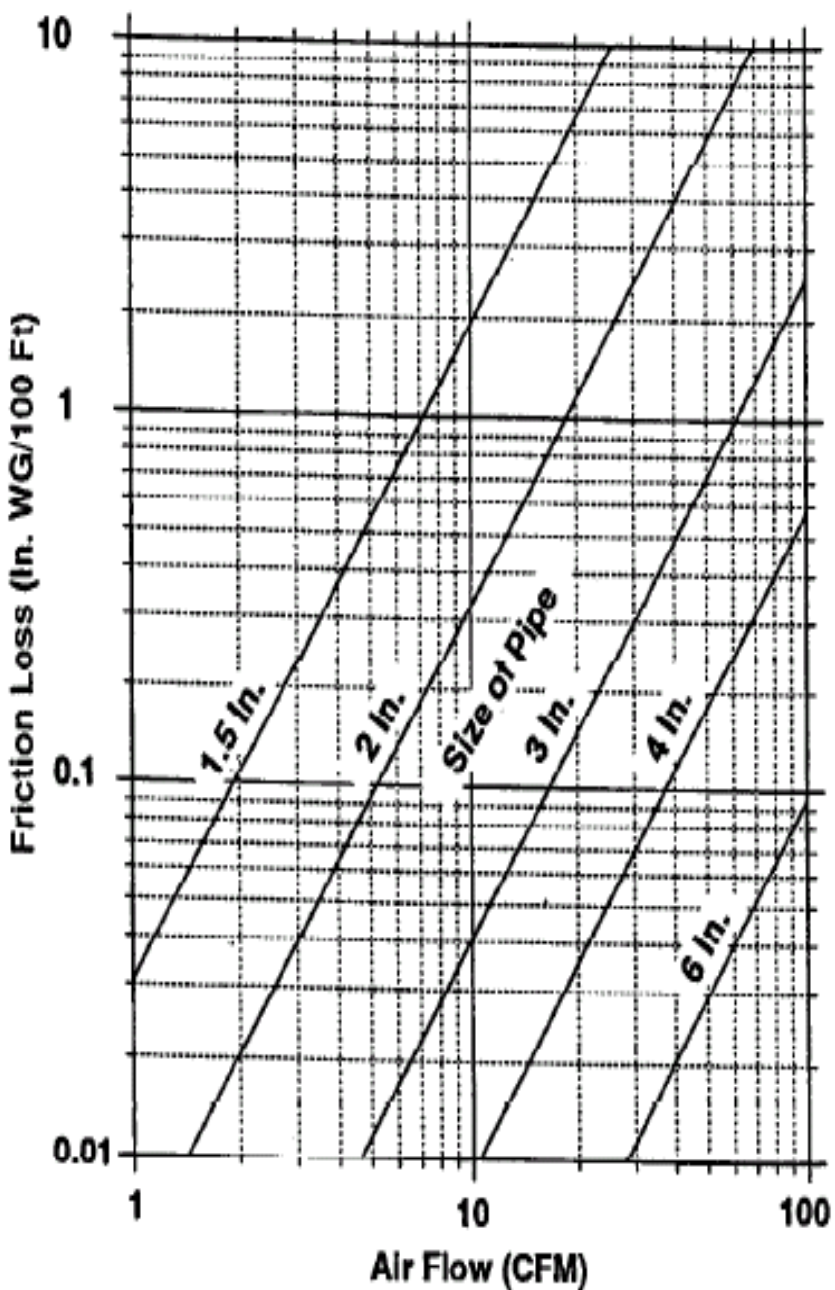




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Frictional pressure loss per 100 ft of pipe





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Number and Location of Suction Points

- One suction point:
 - Sub-slab layer of aggregate
 - Footing drains
 - Cavity under slab (subsidence)
- Two or more:
 - Tight soils (silts and fine sands)
 - Discontinuous cavities or stone pebbles



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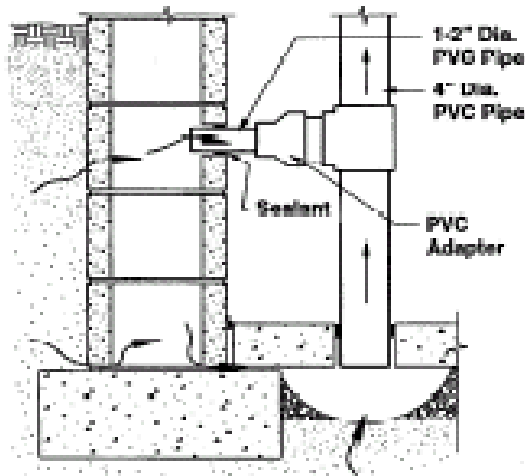
Types of Soil Depressurization Systems

- Block wall suction
- Drain-tile suction
- Sub-slab suction
- Sub-slab pressurization
- Sub-membrane depressurization

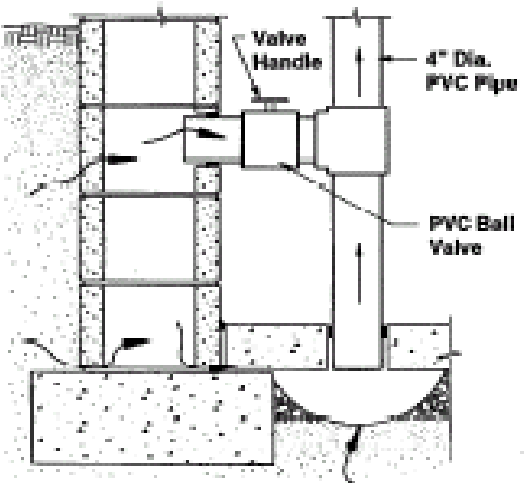


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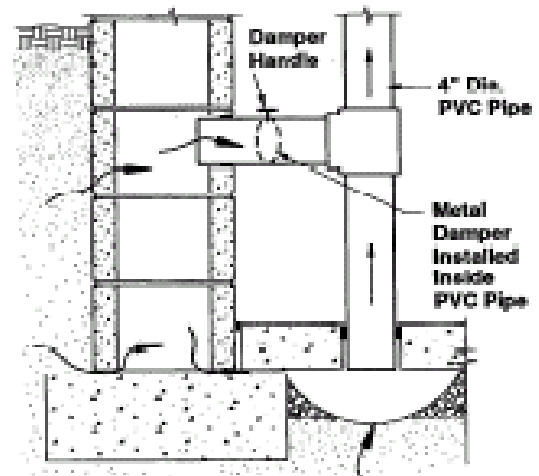


A) Reduced-diameter suction pipe installed in wall in order to reduce air flow out of wall, preventing QWD flows from overwhelming SS/D system.



C) PVC ball valve installed to adjust, restrict wall flows

Note: Metal Dampers May Not Always Reliably Restrict Flows.



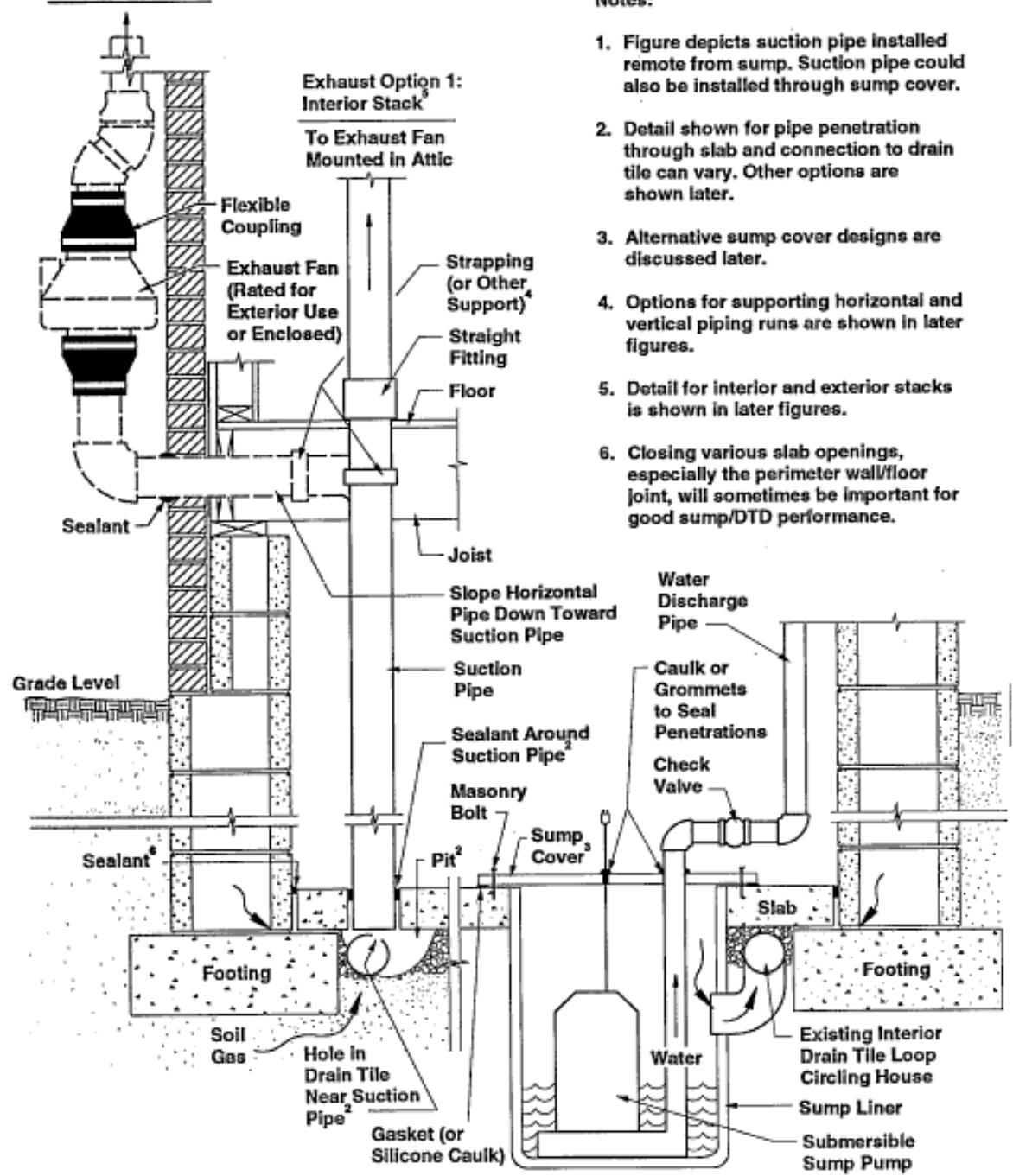
B) Metal damper installed in PVC pipe penetrating wall, to enable adjustment, restriction of air flow out of wall.



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**Exhaust Option 2:
Exterior Stack**



Notes:

1. Figure depicts suction pipe installed remote from sump. Suction pipe could also be installed through sump cover.
2. Detail shown for pipe penetration through slab and connection to drain tile can vary. Other options are shown later.
3. Alternative sump cover designs are discussed later.
4. Options for supporting horizontal and vertical piping runs are shown in later figures.
5. Detail for interior and exterior stacks is shown in later figures.
6. Closing various slab openings, especially the perimeter wall/floor joint, will sometimes be important for good sump/DTD performance.

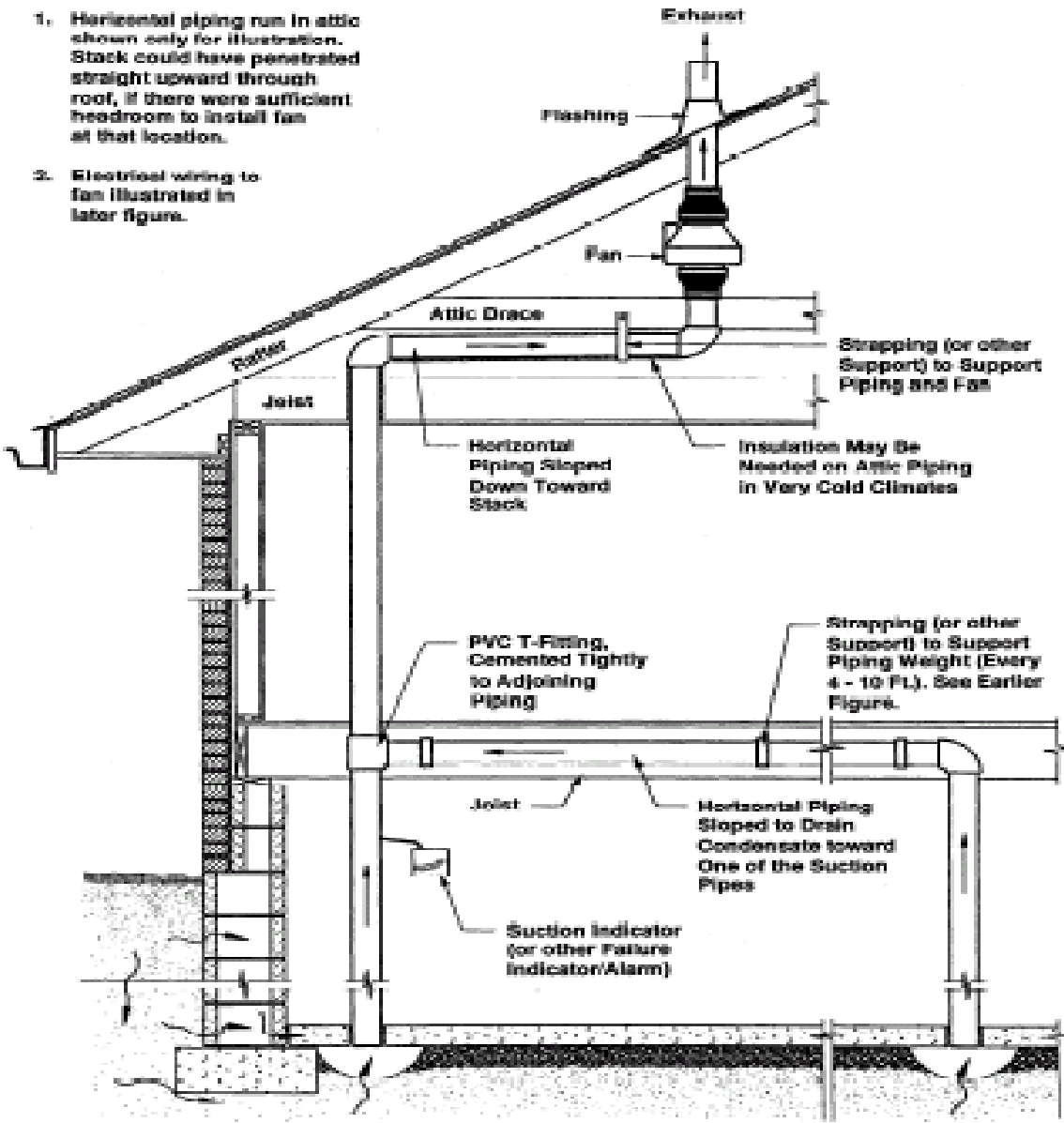


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Notes:

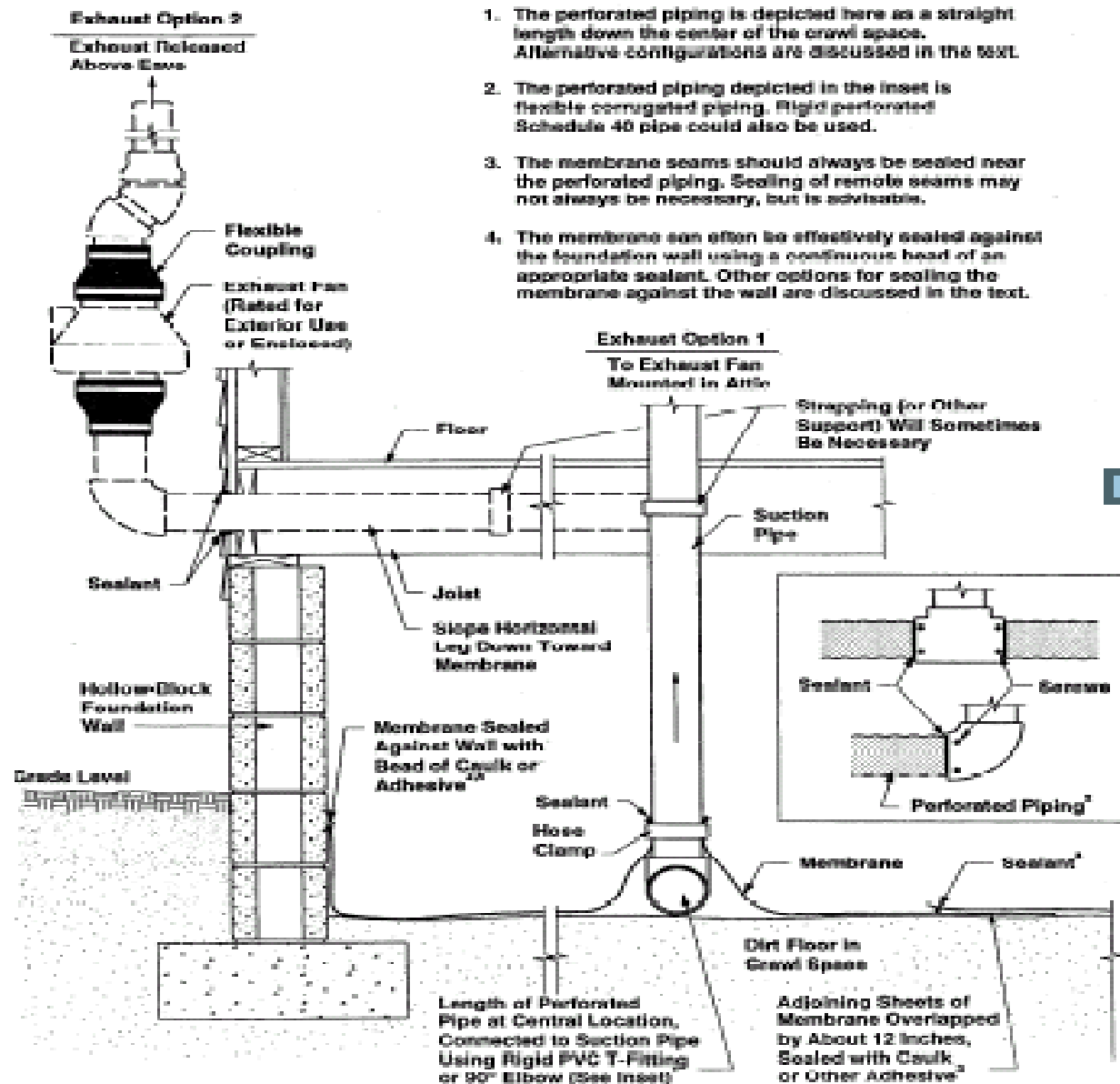
1. Horizontal piping run in attic shown only for illustration. Stack could have penetrated straight upward through roof, if there were sufficient headroom to install fan at that location.
2. Electrical wiring to fan illustrated in later figure.





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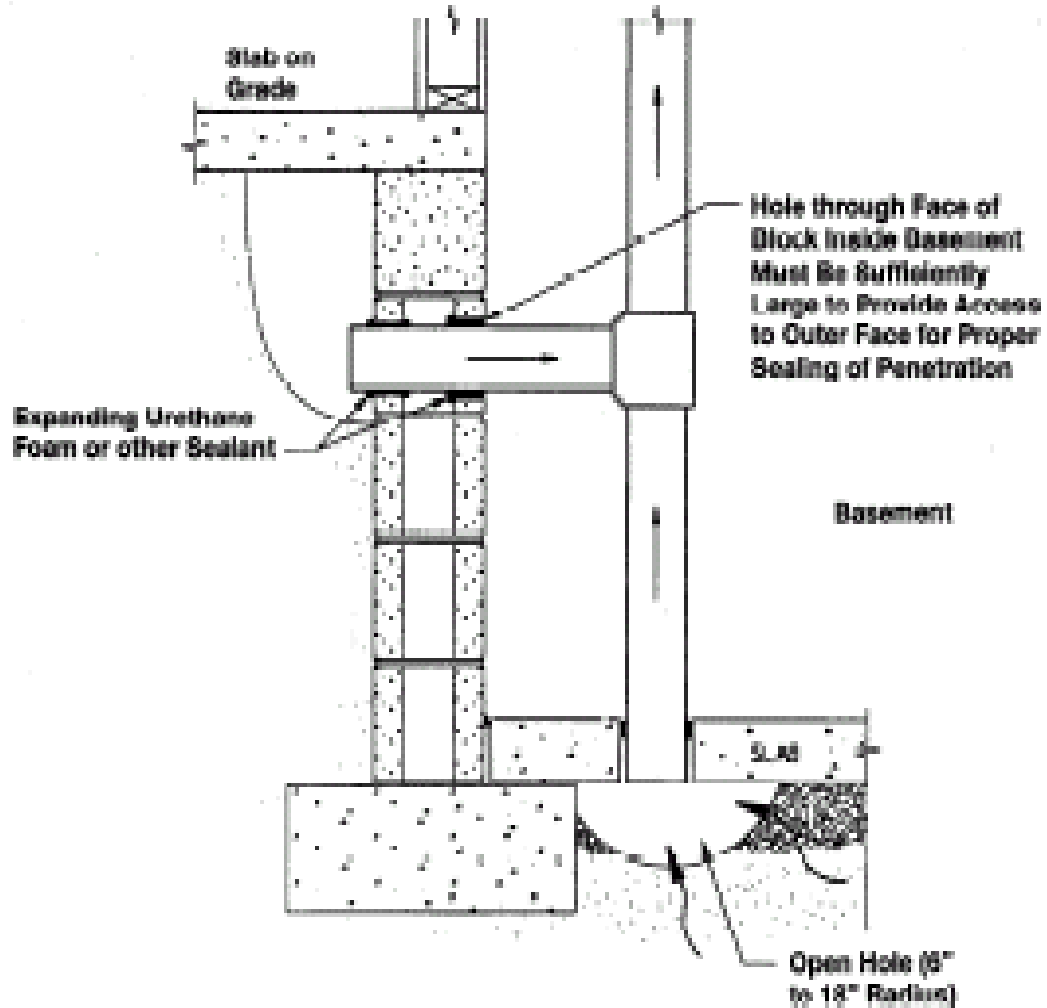




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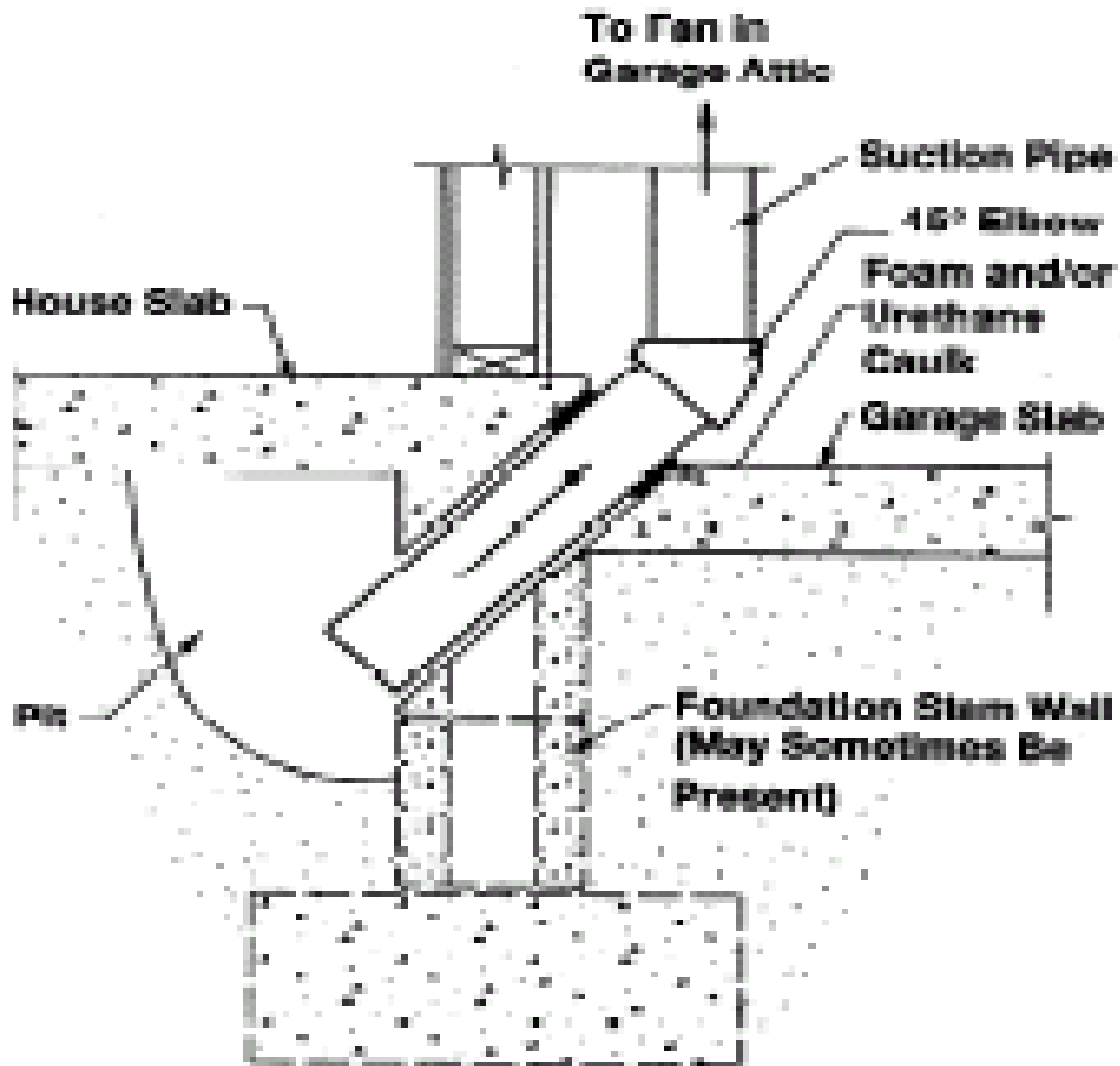
Note: Careful sealing of pipe penetration through outer face of block can be important to prevent excessive leakage of air into the system via the block wall.





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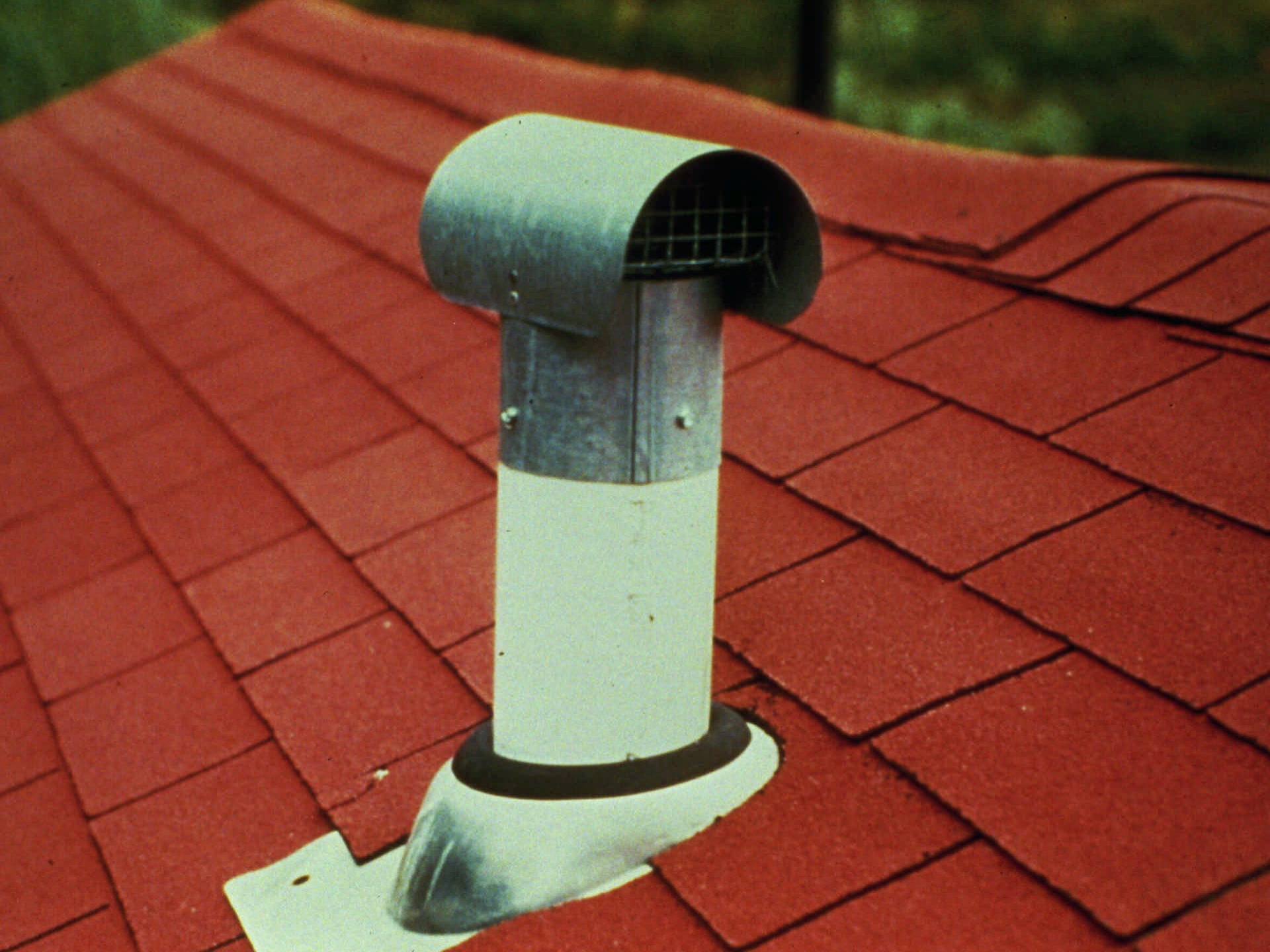


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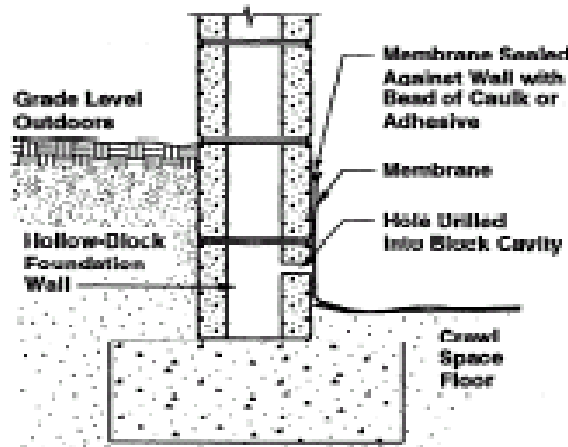
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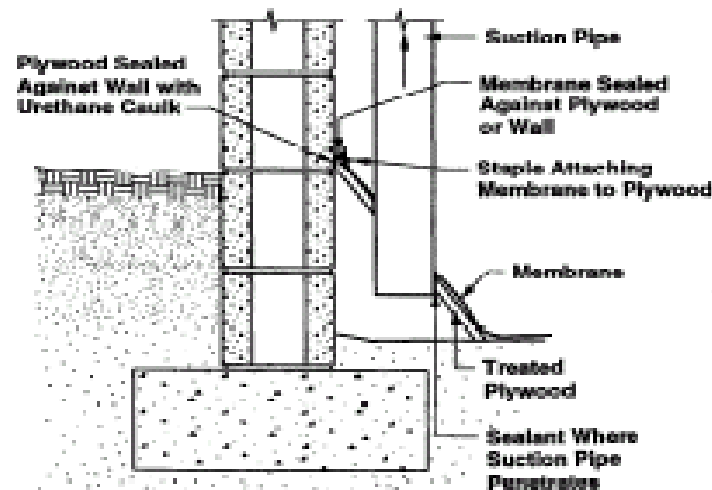


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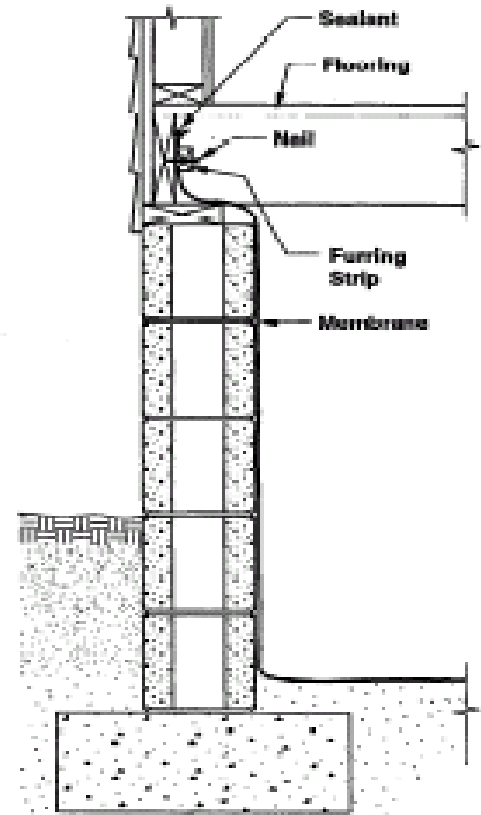
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A) Holes drilled through inside face of block at intervals, below the point at which the membrane is sealed against the wall.



C) Channel created around crawl-space perimeter using plywood; suction drawn on channel.



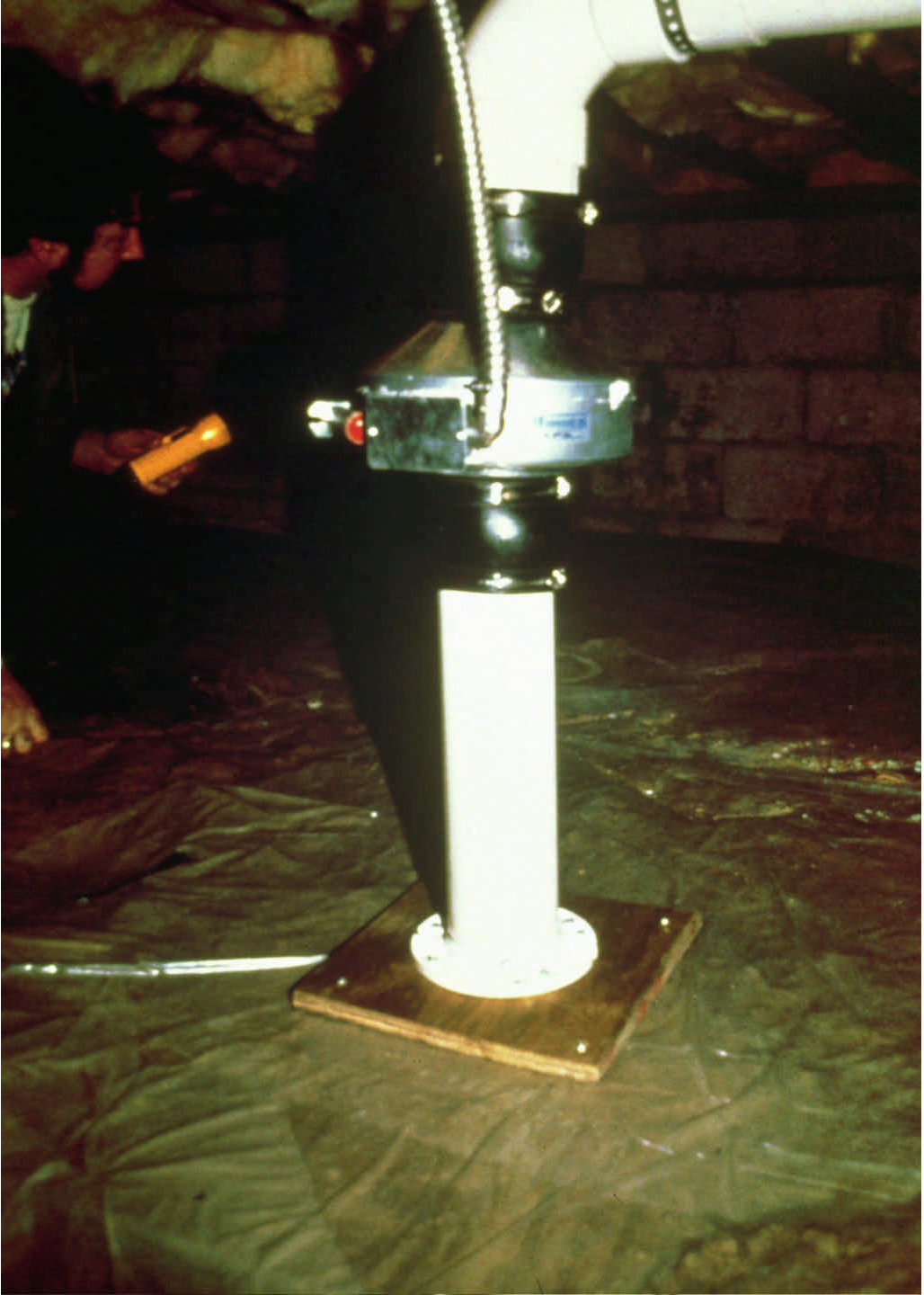
B) Membrane extended upward to cover entire wall, sealed to band joint.





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References

- Guidance for ASD Systems EPA/625/R-93/011
- Radon Ref. Manual EPA/520/1-87/20
- Radon Mitigation Standard EPA/402/R-93/078
- Model Standards for New Construction
EPA/402/R-94/009
- Engineering Design Criteria for SSD Systems
EPA/600/8-90/63
- Radon Reduction Methods EPA/625/5-88/024
- ASTM E2121 Standard Practice for Radon
Mitigation in Existing Residential Bldgs
- ASTM E2435-05 Standard for Application of
Engineering Controls to Facilitate Use or
Redevelopment of Chemical-Affected Properties
- Indoor Air Vapor Intrusion Mitigation Approaches
EPA/600/R-08-115



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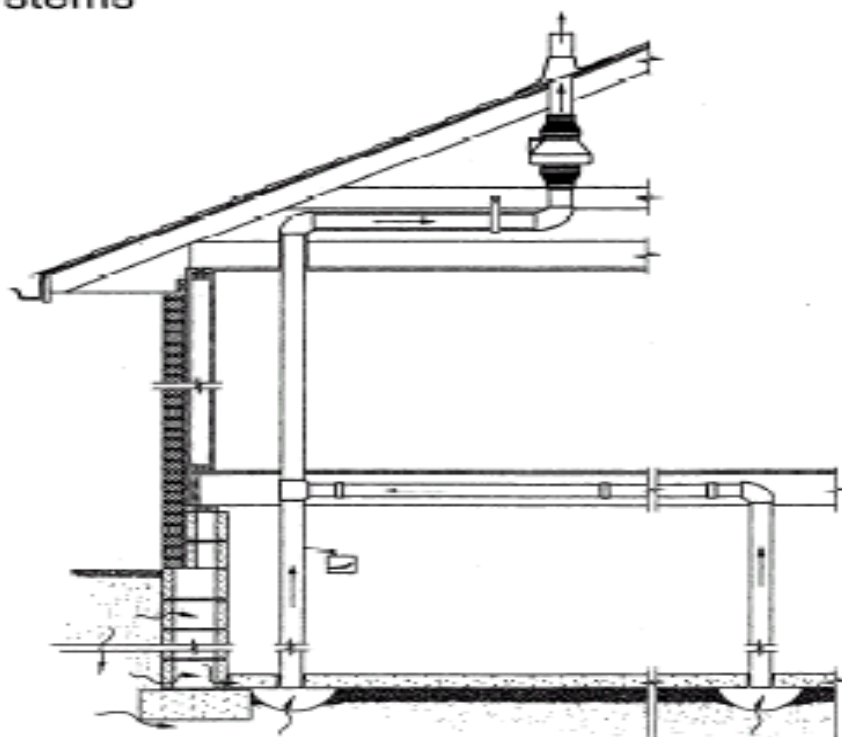
United States
Environmental Protection
Agency

Office of Research and
Development
Washington DC 20460

EPA/625/R-93/011
October 1993

Radon Reduction Techniques for Existing Detached Houses

Technical Guidance
(Third Edition) for
Active Soil Depressurization
Systems





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Summary

- Elevated soil gas contaminants in the near zone are likely to enter the building
- Intervention is effective and affordable
- As a mitigation method, Sub-slab depressurization often leads to valuable side effects
 - Reduces a wide variety of volatile contaminants including radon
 - Reduces moisture, mold, and musty odors
 - May eliminate need for special dehumidification equipment
- These additional benefits may impact the decision whether to deactivate the system when remediation has been successful



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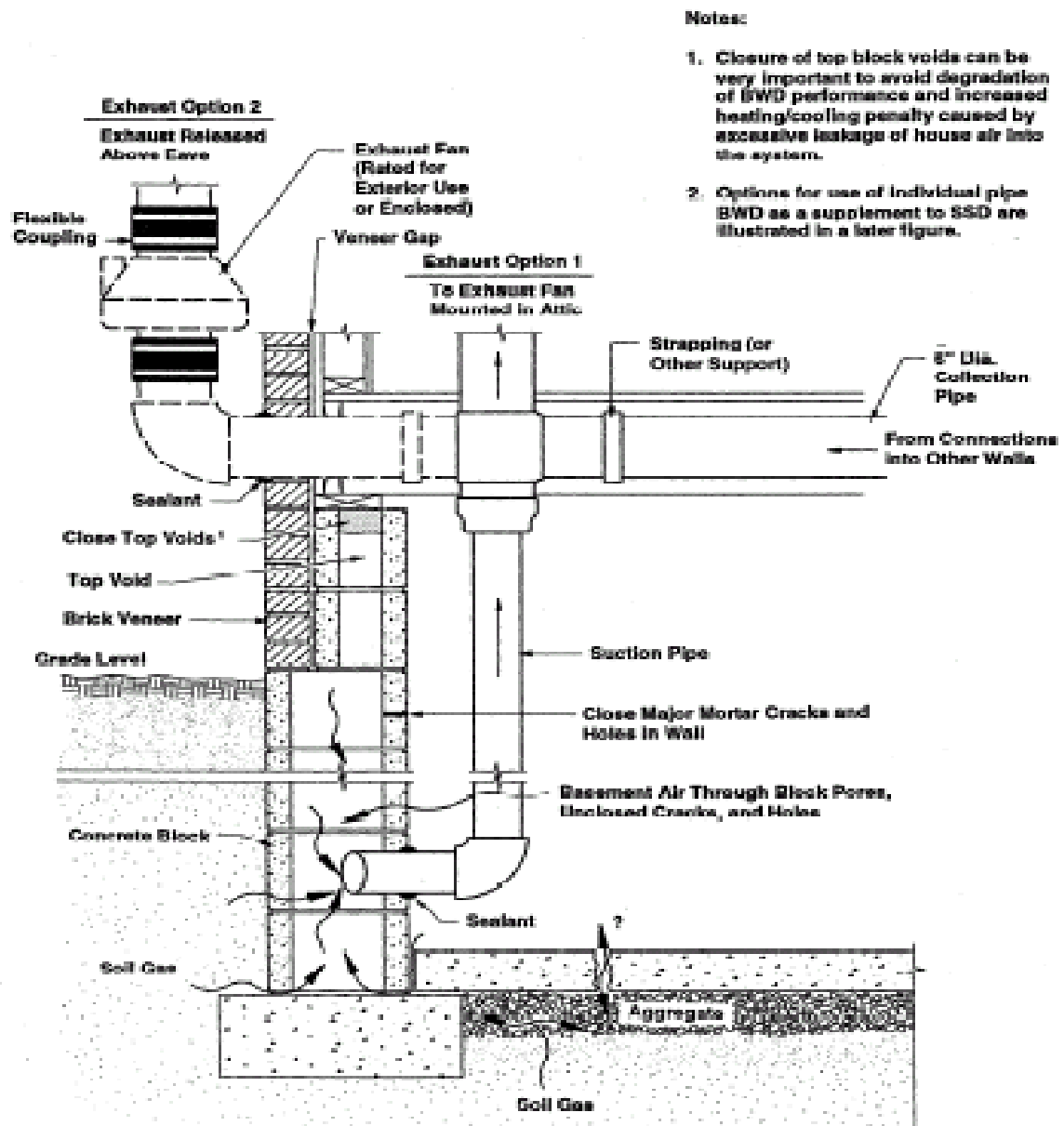
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- Extra slides for potential use in discussion period



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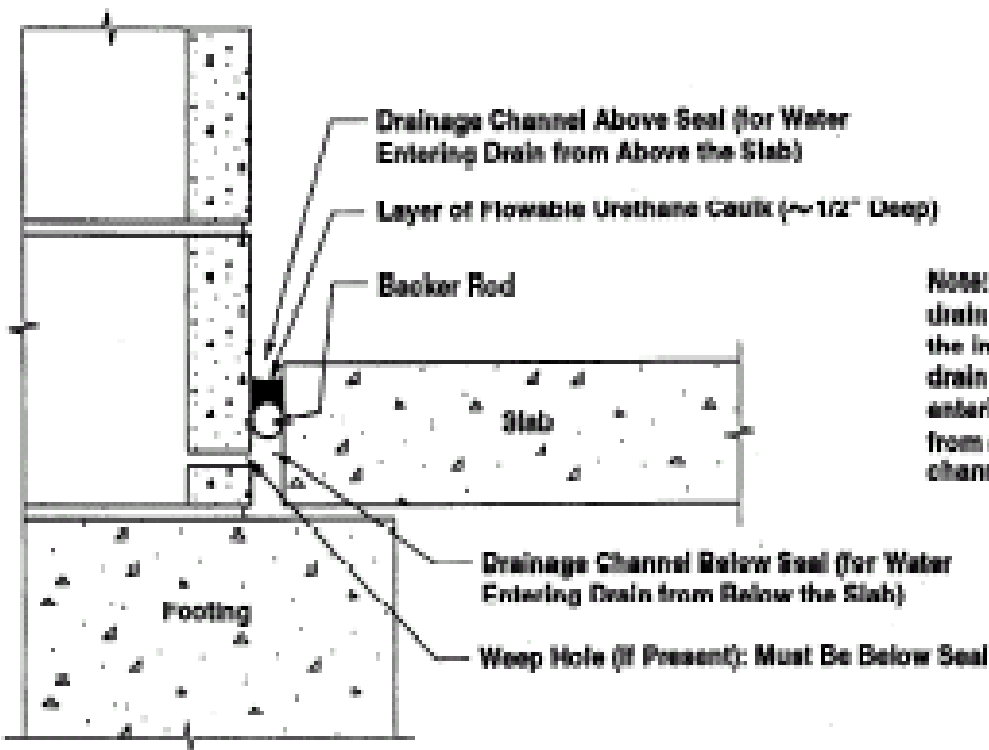
Notes:

1. Closure of top block voids can be very important to avoid degradation of BWD performance and increased heating/cooling penalty caused by excessive leakage of house air into the system.
2. Options for use of individual pipe BWD as a supplement to SSD are illustrated in a later figure.



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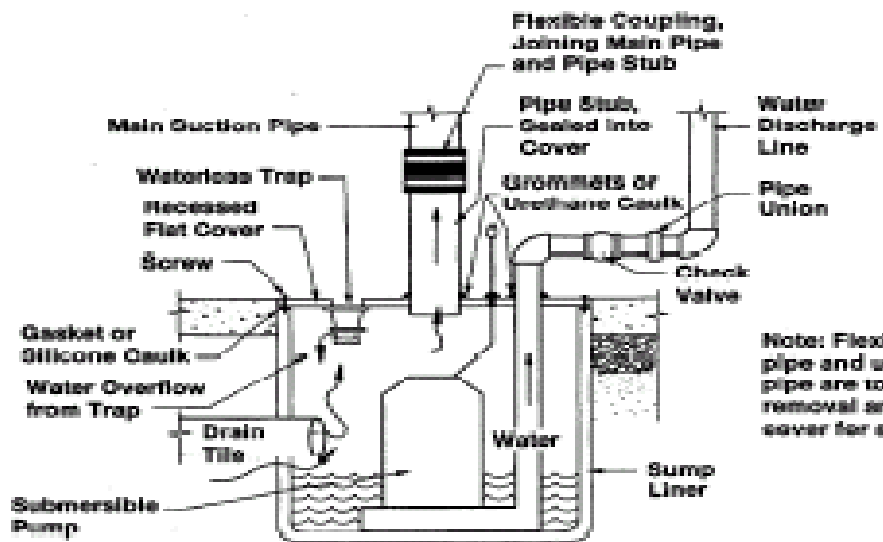


Note: Sealing a perimeter channel drain in this manner may necessitate the installation of a sump, if the drain is used to collect water entering from above. If water flow from above is heavy, sealing the channel drain may not be advisable



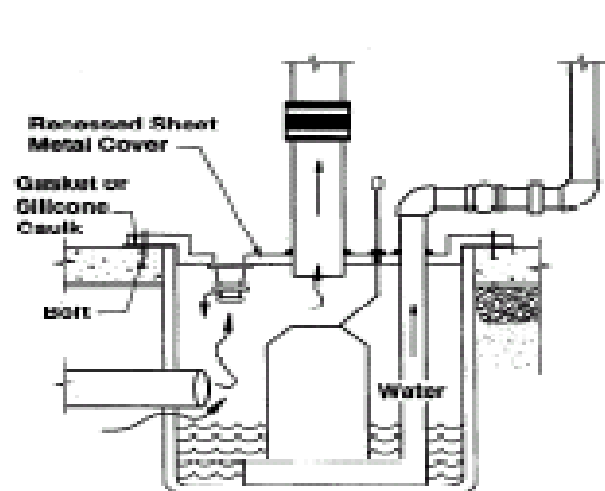
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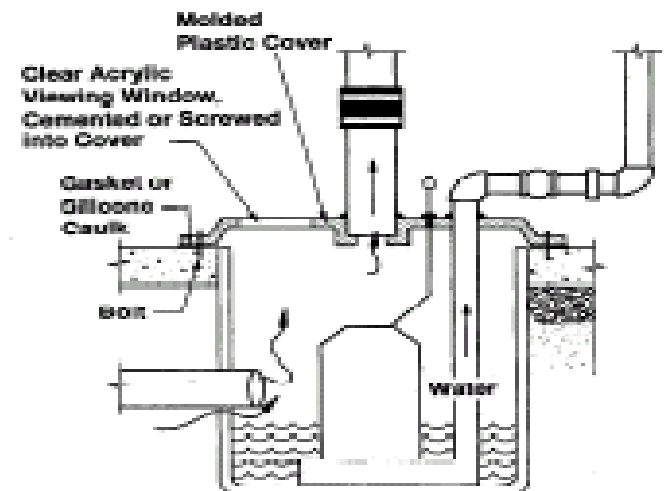


Note: Flexible coupling in suction pipe and union in water discharge pipe are to facilitate subsequent removal and replacement of sump cover for sump/pump maintenance.

A) Sump liner forms a lip just below slab surface; lip used to support a flat circular cover.



B) Recessed cover designed to be supported by top of slab.

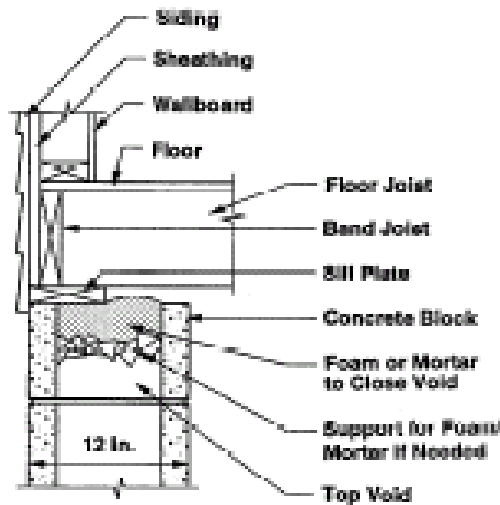


C) Raised cover typical of some commercially available covers.

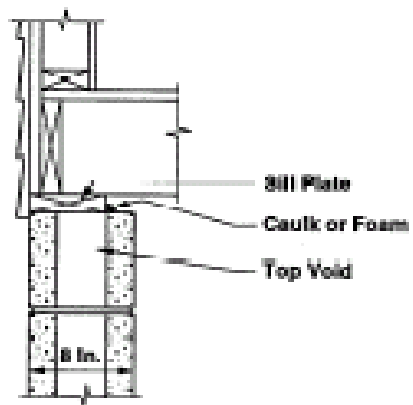


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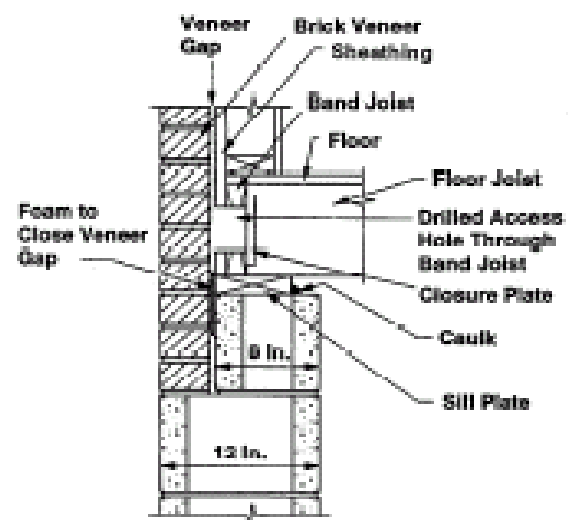
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A) Closure of top void when void is reasonably accessible.



B) One option for closure of top void when a fraction of an inch of the void is exposed.



C) One option for closing gap between exterior brick veneer and interior block and sheathing.